FINAL REPORT

Assessment of Geology, Energy, and Minerals (GEM) Resources

CEDAR MOUNTAIN GEM RESOURCE AREA

(OR-030-17)

MALHEUR COUNTY, OREGON

Prepared for

United States Department of the Interior
United States Bureau of Land Management
Scientific Systems Development Branch

March 1983

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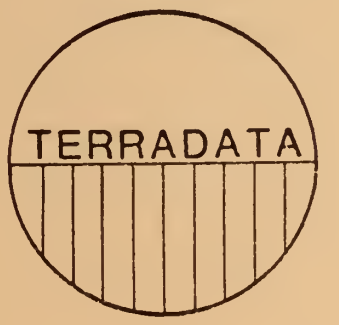

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Assessment of Geology, Energy, and Minerals (GEM) Resources

Cedar Mountain GRA (OR - 030 - 17) Malheur County, Oregon

Prepared For:

United States Department of the Interior
United States Bureau of Land Management
Scientific Systems Development Branch

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This report was prepared as part of a Phase I Assessment of GEM Resources within designated Wilderness Study Areas in Oregon, Idaho and Nevada.

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DISCLAIMER

This document is part of a report prepared under Contract Number YA - 553 - CT2 - 1042 for the United States Department of the Interior, Bureau of Land Management. Although officials of the Bureau of Land Management have provided guidance and assistance in all stages of the project, the contents and conclusions contained herein do not necessarily represent the opinions or policies of the Bureau.

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- Dr. Antonius Budding - Oil Shale and Tar Sands
- Mr. Raymond Corcoran - Field Verification
- Dr. James Firby - Paleontology
- Mr. Ralph Mason - Coal
- Mr. Richard Miller - Uranium and Thorium
- Mr. Vernon Newton - Oil and Gas
- Mr. Herbert Schlicker - Industrial Minerals and Geologic Hazards
- Dr. Walter Youngquist - Geothermal
- Dr. Paul Weis - Metals and Non - Metals.

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Mr. Tom Mitchell assisted in the stream sediment sampling program. Bondar - Clegg provided the geochemical analysis of stream sediment samples.

Ms. Pamela Ruhl provided clerical and editorial assistance throughout the project. Ms. Sara Mathews assisted with occurrence information and drafting. Mr. Philip R. Jones and Mr. Michael A. Becker produced all documents relating to the project using TERRADATA's word processing and document production systems.

EXECUTIVE SUMMARY

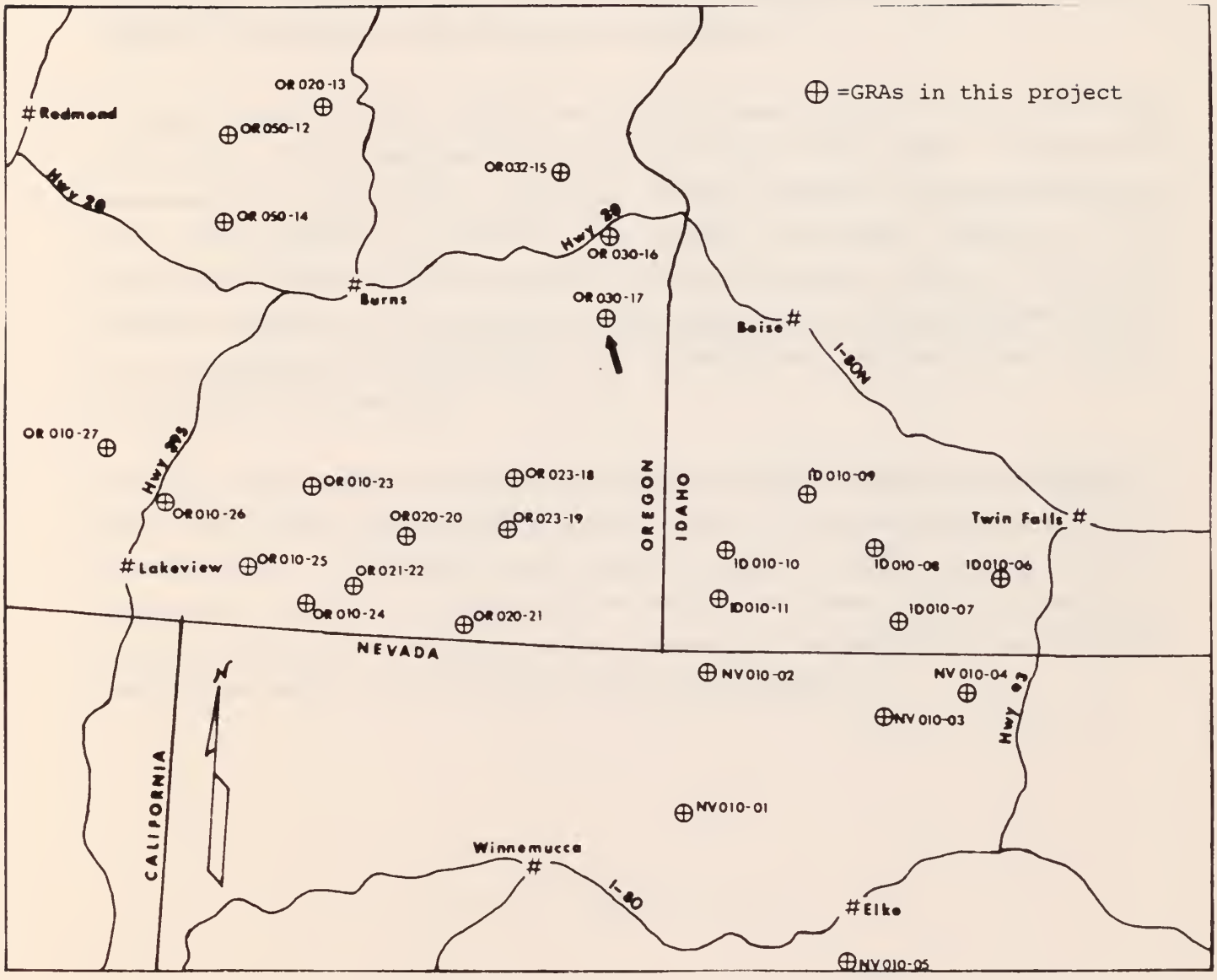
The purpose of this project is to evaluate and classify environments favorable for the occurrence of geology, energy, and minerals (GEM) resources in selected wilderness study areas (WSAs) in southeastern Oregon, southwestern Idaho, and northern Nevada. **(See TERRADATA report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources.")** GEM resource environments have been rated on a scale that ranges from one to four, with one being least favorable and four being most favorable. Favorability classes two and three represent low and moderate favorability, respectively. Confidence levels range from A to D with A being low confidence and D being high confidence. The confidence levels are directly related to the quantity and quality of the information available for the determination of the favorability classes.

The specific area with which this report deals is the Cedar Mountain GRA (GRA number OR - 030 - 17) which is located in southeastern Oregon (see attached location map). The GRA contains about 324 square miles within Townships 25S through 27S and Ranges 40E through 43E. It contains two WSAs; WSA 3-47 (33,000 acres), and WSA 3-73 (12,800 acres). The study area is in the Northern Malheur Resource Area of the Vale BLM District.

The Cedar Mountain GRA is in the High Lava Plains sub-province of the Columbia Intermontane physiographic province. Rocks exposed in the GRA are all Tertiary or younger volcanic and volcaniclastic strata. Limited exposures of lacustrine units occur within the GRA. The area contains no major structural features apparent on the surface. Basin and Range block faulting is not apparent in the area because of the thick mantle of Tertiary volcanics. The Cedar Mountain GRA is not near any known mineral belts or mining districts. Historically, the area has had no significant production of any GEM resources.

The geologic environments and inferred geologic processes indicate moderate favorability for the accumulation of some GEM resources in the Cedar Mountain GRA. Except for geothermal resources, the nature of the data available the the geometry of potential geologic environments do not permit subdivision of the GRA into areas of commodity specific favorability.

GRA Location Map

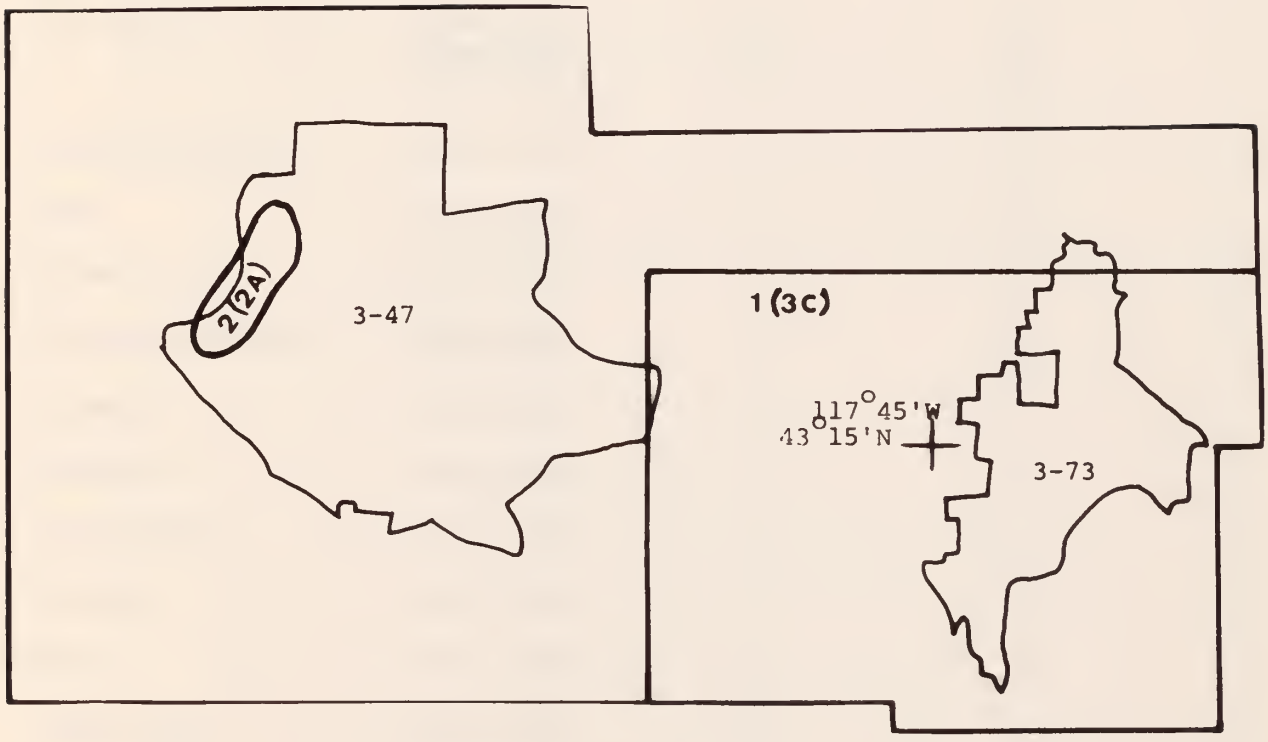


The Cedar Mountain GRA contains geologic environments that are moderately favorable for the occurrence of geothermal, oil and gas, and paleontological resources. The entire GRA has a low favorability for oil shale and tar sands, diatomite, and perlite resources in accordance with the BLM classification scheme (see attached land classification map); the geologic environment, the inferred geologic processes, and known occurrences indicate low favorability for the occurrence of these resources.

The Cedar Mountain GRA exhibits no favorable characteristics for all other GEM resources (see GEM Classification and Confidence Level Table below). Evaluation of environments for metals, coal, uranium and thorium, limestone and zeolite resources have varying degrees of confidence. In general, environments essential for the accumulation these resources do not exist within the study area. Except for metals and limestone resources, all of the least favorable classifications have low confidence levels (A or B) signifying that insufficient or only minimal indirect information was available for the respective evaluations.

Further surface geologic investigations, including detailed mapping and stratigraphic studies, could enhance the confidence levels of many of the classifications in the Cedar Mountain GRA. It is doubtful, however, that the original classifications would change substantially. Sub-surface investigations are probably not warranted in this area due to the costly nature of the available methods. Geophysical and geochemical surveys might provide some insight into the potential resources in the study area.

Land Classification Map
Cedar Mountain GRA
(OR - 030 - 17)
Malheur County, Oregon



Scale 1:250,000
(Boise $1^{o}x2^{o}$ NTMS Quadrangle)

Classification Of Lands Within The
Cedar Mountain GRA
(OR - 030 - 17)
Malheur County, Oregon
For GEM Resource Potential

COMMODITY	AREA	CLASSIFICATION LEVEL	CONFIDENCE LEVEL	REMARKS
Metals	Entire GRA	1	B	
Geothermal	Area 1-3C	3	C	
	Area 2-2A	2	A	
	Rest of GRA	1	A	
Uranium/Thorium	Entire GRA	1	A	
Coal	Entire GRA	1	B	
Oil and Gas	Entire GRA	3	B	
Tar Sands/Oil Shale	Entire GRA	2	B	
Diatomite	Entire GRA	2	C	
Limestone	Entire GRA	1	C	
Clinoptilolite	Entire GRA	1	A	
Bentonite	Entire GRA	2	A	
Perlite	Entire GRA	2	A	
Paleontology	Entire GRA	3	B	
Hazards	See Hazards Map (GRA File)			
ESLs	None	1	C	

LEGEND:
Class 1 - Least Favorable
Class 2 - Low Favorability
Class 3 - Moderate Favorability
Class 4 - High Favorability

Confidence Level A - Insufficient data or no direct evidence
Confidence Level B - Indirect evidence available
Confidence Level C - Direct evidence but quantitatively minimal
Confidence Level D - Abundant direct and indirect evidence

TABLE OF CONTENTS

TABLE OF CONTENTS
(Concluded)

Figures

Table

1. INTRODUCTION

This report is one of 27 GRA technical reports that summarize the results of a Phase I assessment of the geology, energy, and minerals (GEM) resources in selected portions of southeastern Oregon, southwestern Idaho, and northern Nevada. The study region was subdivided into 27 GEM resource areas (GRAs), principally for ease of data management and interpretation. The assessment of GEM resources for this project consisted of an interpretation of existing literature and information by experts knowledgeable in both the geographic area and specific commodities. A restricted field verification program also was conducted. It is possible that the assessment would be different if detailed field exploration, geochemical sampling, and exploratory drilling programs were undertaken. (See the TERRADATA report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources.")

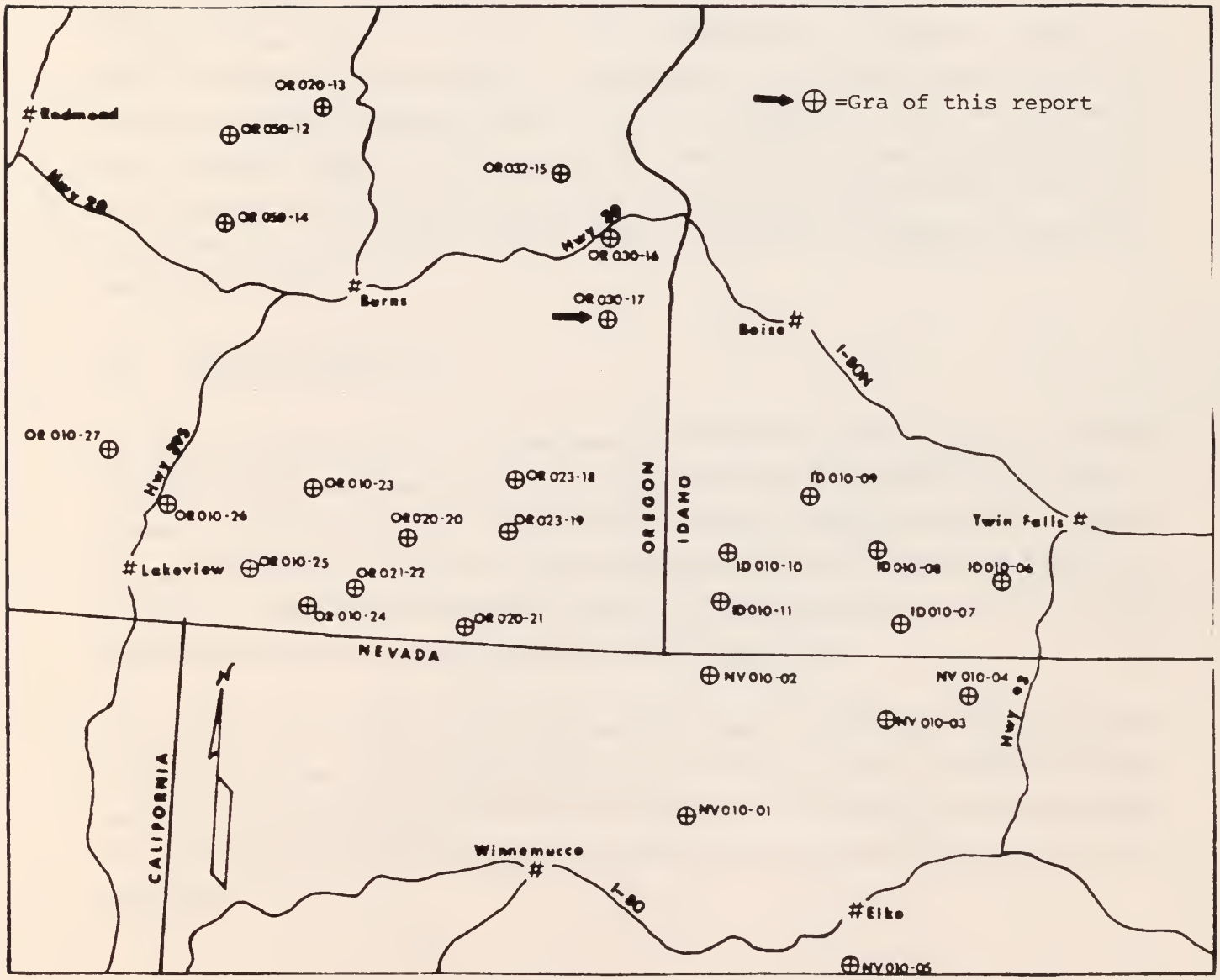
This report summarizes the assessment of the GEM resources potential of the Cedar Mountain GRA (OR-030-17). See Figure 1-1. Commodity categories for which this GRA was evaluated are:

- Metals
- Oil and Gas
- Oil Shale and Tar Sands
- Geothermal
- Uranium and Thorium
- Coal
- Industrial Minerals
- Paleontological Resources
- Geologic Hazards
- Educational and Scientific Localities (ESLs)

Geologic environments within the Cedar Mountain GRA have been rated with respect to their favorability for the occurrence of these different commodities. The favorability rating scale ranges from one to four, with one being least favorable and four being most favorable. Confidence levels in these ratings also have been assigned. These confidence levels range from A to D, with A being low confidence and D high confidence. Assigned confidence levels are related to the quantity and quality of the information available for the determination of the favorability ratings.

FIGURE 1-1

GRA Location Map



2. DESCRIPTION OF THE CEDAR MOUNTAIN GRA

2.1 LOCATION

The Cedar Mountain GRA (OR-030-17) is in southeast Oregon. It lies between latitudes 43°03'N and 43°28'N and longitudes 117°20'W and 117°57'W. The GRA contains approximately 324 square miles within Townships 25S through 27S and Ranges 40E through 43E (see Figures 1-1 and 2-1). The area contains two Wilderness Study Areas, WSA 3-47 (33,000 acres), and WSA 3-73 (12,800 acres). The Cedar Mountain GRA is in the Northern Malheur Resource Area of the Vale BLM District. The area is about 50 miles from Vale, Oregon, which is the nearest transportation center offering a minimum of rail, highway, and/or charter-air services. Access to the contained WSAs is via county maintained dirt or packed-gravel roads. Vehicular access to the interior of the WSAs is poor to non-existent.

2.2 GENERAL GEOLOGY

The Cedar Mountain GRA is in the Boise 1°x2° NTMS quadrangle map in southeast Oregon. The data available for this area includes NURE investigations[1, 2, 3,]*, general mineral resource information[4], and limited small scale geologic mapping[5]. Detailed geologic information is lacking for most areas within the GRA. Occurrence information evaluated for this GRA includes MILS, CRIB, NURE, claims, and leases. The overall quality and quantity of commodity-specific information is poor.

The Cedar Mountain GRA is in the Malheur-Boise Basin Section of the High Lava Plains sub-province of the Columbia Intermontane physiographic province. The High Lava Plain sub-province is analogous to the Columbia Basin to the north, except for having younger lavas, a lesser amount of dissection, and common inter-flow beds of fluvial and lacustrine materials.

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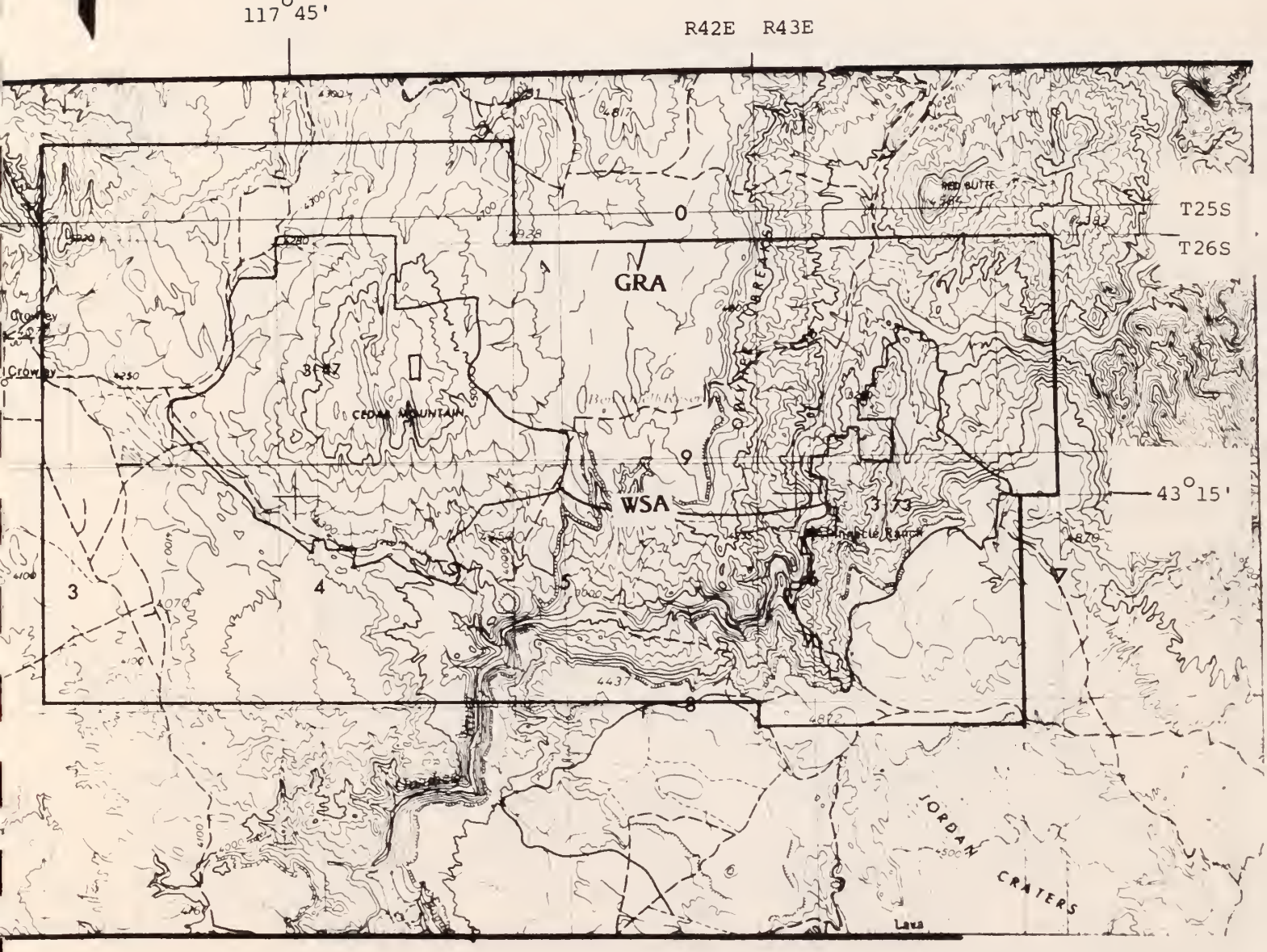
* In this report, citations are superscripted numbers. They refer to bibliographic entries listed in Appendix A, References Cited.

FIGURE 2-1

Topographic Map
Cedar Mountain GRA
(OR - 030 - 17)
Malheur County, Oregon



Scale 1:250,000
(Boise 1°x2° NTMS Quadrangle)

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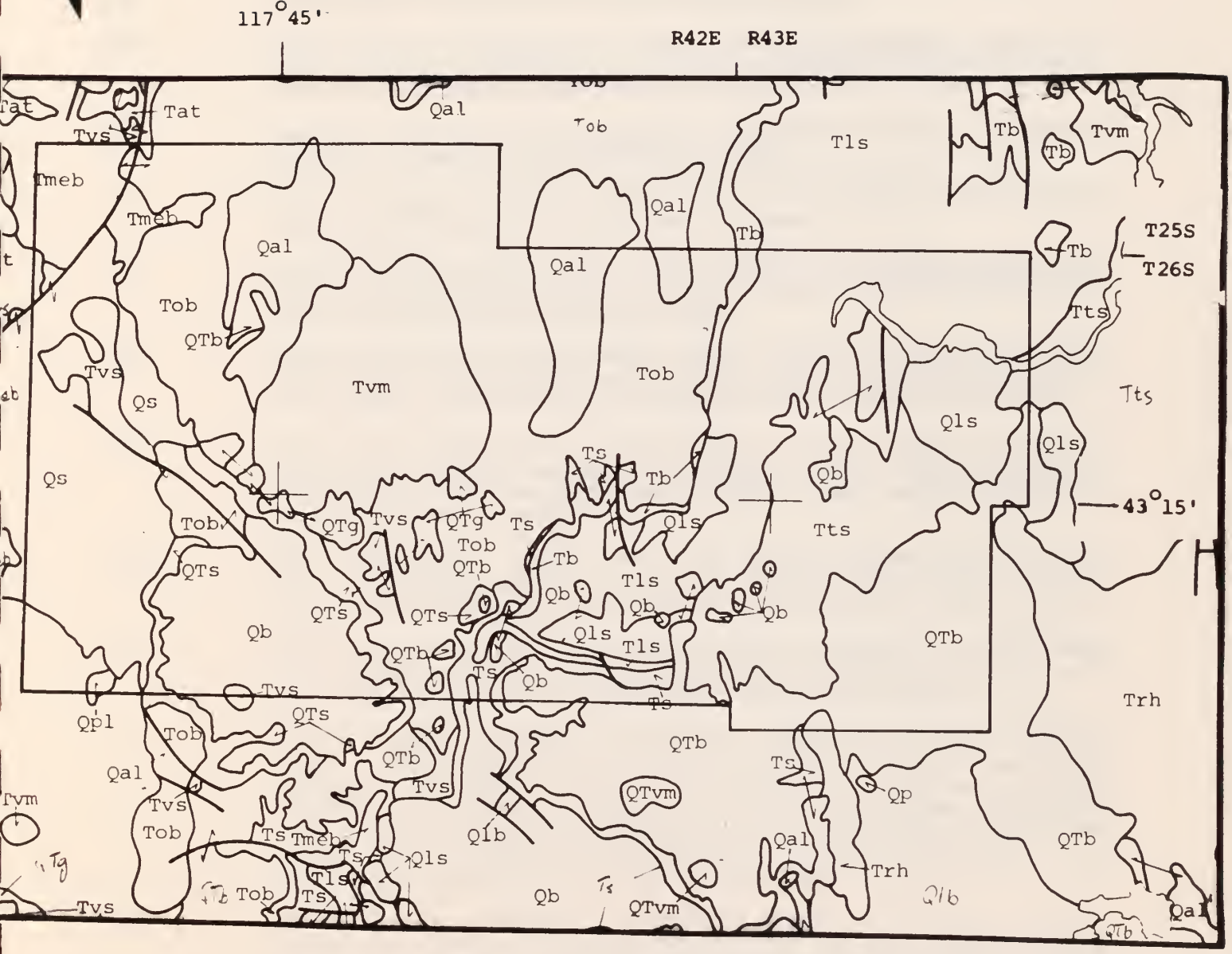
FIGURE 2-2

Geologic Map
Cedar Mountain GRA
(OR - 030 - 17)
Malheur County, Oregon



Scale 1:250,000
(Boise 1°x2° NTMS Quadrangle)

FIGURE 2-2
(Continued)

Geologic Map Legend For
Cedar Mountain GRA
(OR - 030 - 17)
Malheur County, Oregon

Qal - Alluvium

Qpl - Playa Deposit: Clay, silt, sand, and some evaporites.

Qlb - Late Basalt: Thin flows of scoriaceous olivine-bearing basalt; upper surfaces of flows characterized by blocky or pahoehoe structures and by pressure ridges and tumuli; all essentially unmodified by erosion.

Qls - Landslide and Debris Flow Deposits: Unstratified mixtures of Basaltic, andesitic, tuffaceous, and sedimentary bedrock.

Qb - Basalt: Mostly thin flows of olivine basalt. Also includes some dissected valley flows of basalt and related vent complexes.

Qs - Lacustrine Sedimentary Rocks: Unconsolidated to semiconsolidated lacustrine clay, silt and gravel, in places includes some fluvial and eolian deposits and discontinuous layers of peat.

QTb - Basalt and Tuffaceous Sedimentary Rocks: Thin flow of olivine basalt and minor basalt flow breccia; locally contains thin interbeds of sedimentary rocks; grades laterally through palagonite tuff and breccia into unit QTs.

QTs - Basalt and Tuffaceous Sedimentary Rocks: Semiconsolidated lacustrine fluvial, ashy, and palagonitic sedimentary rocks; mostly tuffaceous sandstone and siltstone. QTs grades laterally through palagonitic tuff and breccia into flows of unit QTb.

QTvm - Mafic Vent Rocks: Basaltic vent rock, mostly in shield volcanoes, lava cones, and constructional lava domes; includes agglomerate, breccia, scorria, cinders, ash, restricted flows, and small basaltic intrusive bodies.

Tob - Olivine Basalt, Tuffaceous Sedimentary Rocks, and Silicic Ash Flow Tuffs: Thin olivine basalt flows, in places intercalated with clastic rocks of unit Ts; grades laterally through palagonitic breccia tuff into unit Ts.

Ts - Olivine Basalt, Tuffaceous Sedimentary Rocks, and Silicic Ash-Flow Tuffs: Semiconsolidated to well consolidated mostly lacustrine, tuffaceous sandstone, siltstone, concretionary claystone, pumicite, diatomite, vitric-ash, and palagonitic tuff and tuff breccia. Palagonitic tuffs and breccias grade laterally into altered and unaltered basalt flows of unit Tob. In places includes layers of fluvial conglomerate. Also includes this welded and non-welded ash-flow tuffs.

Tat - Olivine Basalt, Tuffaceous Sedimentary Rocks, and Silicic Ash-Flow Tuffs: Vitric and vitric-crystal ash-flow tuff and associated pumiceous air-fall tuff mostly of rhyolitic and rhyodacitic composition; includes minor tuffaceous sedimentary rocks; in places it represents only welded parts of ash-flow tuffs; grades laterally through less densely welded tuff to non-welded ash-flow tuff and interlayered tuffaceous sediments of unit Ts.

FIGURE 2-2
(Concluded)

Geologic Map Legend For
Cedar Mountain GRA
(OR - 030 - 17)
Malheur County, Oregon

Tb - Basalt: Basalt flows and flow breccias. Tuff and tuffaceous sedimentary rocks interbedded in places. Includes Picture Gorge Basalt and flows of the Deer Butte Formation.

Tvm - Mafic Vent Rocks: Basaltic and andesitic agglomerate, breccia, scorria, cinders, flows, and instrusive masses forming constructional volcanic features, mostly laval cones and small shields.

Tvs - Silicic Vent Rocks: Plugs and exogenous domal complexes of rhyolitic to dacitic composition; includes related near vent flows, flow breccias and pumiceous deposits. Locally includes obsidian and perlite. Source areas for some ash-flow tuffs.

Tmeb - Basaltic and Silicic Flows, Breccias, Welded Ash-Flow Tuffs, Tuffaceous Sedimentary Rocks, Lacustrine and Fluvial Deposits: Undifferentiated fissure sourced plateau basalt with interbedded fresh water sediments Tls and Tts. Oregon includes the basalt flows and breccias of Yakima Basalt, the Picture Gorge Basalt, Imnaha Basalt of the Columbia River Group, Steen Basalt, Steens Mountain Volcanic Series, Owyhee Basalt, Strawberry Volcanics, and Hunter Creek Basalt; fed in part by intrusive rocks of unit Tb.

Tts - Basaltic and Silicic Flows, Breccias, Welded Ash Flow Tuffs, Tuffaceous Sedimentary Rocks, Lacustrine and Fluvial Deposits: Lacustrine and fluvial deposits of tuff, pumicite, palagonitic tuff, and lesser amounts of siltstone, arkosic sandstone, and pebble conglomerate; locally contains some lignite beds. Included are the Mascall Formation, Suckor Creek Formation, Drip Spring Formation, Trout Creek Formation, and the Payette Formation.

Tls - Basaltic and Silicic Flows, Breccias, Welded Ash-Flow Tuffs, Tuffaceous Sedimentary Rocks, Lacustrine and Fluvial Deposits: Poorly to moderately well consolidated, bedded silicic ash and pumice, diatomite, tuff, minor mudflow deposits, and some coarse epiclastic deposits; interfingers and grades laterally into unit Tmeb and includes the Deer Butte and Juntura Formations, the lower part of the Danforth Formation, and the Payette Formation.

Trh - Rhyolitic Flow and Flow Breccias: Flows and flow breccias of rhyolitic, rhyodacitic, and dacitic composition; in places includes interlayers of silicic volcaniclastic rocks, tuffaceous sedimentary rocks, and ash-flow tuffs. Trh is gradational into silicic vent rocks and includes Jump Creek Rhyolite and Littlefield Rhyolite.

 - Fault (dashed where inferred)

 - Geologic contact (dashed where inferred)

2.2.1 Geomorphology

The Cedar Mountain GRA consists of a broad lava plateau into which the Owyhee River is deeply incised. The northwestern part of the GRA is characterized by a thick sequence of lavas and lacustrine sediments. The dominant feature in this area is Cedar Mountain. This is a broad lava dome that is accentuated by its radial drainage pattern. This is the area of WSA 3-47. The southeastern corner of the GRA is essentially featureless lava plain. This plain extends southward into the Jordan Craters.

The canyon of the Owyhee River within the Cedar Mountain GRA varies from narrow and precipitous to broad and stepped. The narrow section of the Owyhee River canyon is in the southernmost part of the GRA. Along most of its length within the GRA, the canyon has an upper rim and slopes steeply to the river bottom.

Cedar Mountain is the highest point in the area, nearly 5,400 feet, and the lowest point is along the Owyhee River, less than 3,000 feet. Local relief along the Owyhee River canyon is nearly 1,000 feet.

2.2.2 Lithology and Stratigraphy

Paleozoic and Mesozoic units may occur at undertermined depths in the Cedar Mountain GRA since this area is within the margins of both the western Triassic and the western Late Paleozoic depositional basins[6]. None of these units, however, are exposed in or near the GRA. Tertiary basalt flows, silicic ash-flows, and interlayered lacustrine beds are the oldest rocks exposed in the Cedar Mountain GRA (Figure 2-2, above).

The majority of rocks in this GRA are Tertiary and Quaternary volcanogenic and lacustrine strata. Tertiary volcanics consist of basal olivine basalt with interbedded lacustrine tuffaceous sandstones, siltstones, and diatomite. Overlying these strata is a sequence of silicic ash-flow tuffs and alkaline olivine basalt. Constructional lava domes and vent-facies volcanics (Cedar Mountain) comprise this topmost laterally continuous unit in the GRA. Quaternary basalts and interbedded lacustrine sediments occur haphazardly throughout the area. These younger basaltic units are sporatically exposed. Of particular importance in the Cedar Mountain GRA is the presence of the lacustrine deposits interbedded with the flow rock. Tertiary and Quaternary lacustrine environments have the potential for containing diatomite and/or bentonite deposits.

2.2.3 Structural Geology

During the Early Paleozoic the tri-state area was the site of marine sedimentation in the north-northeast trending Cordilleran geosyncline. Sedimentation persisted in three sub-parallel belts until the end of the Devonian Period. One sedimentation belt was located in the eastern half of Nevada and received near-shore to littoral deposits of shallow-water carbonates with a minor amount of interbedded shale and sandstone. The second sedimentation belt was in the western half of the state and was the locus of transitional, progressively deeper-water deposits. The third belt, located further west, was the site of eugeoclinal deposits.

In Late Devonian time, the Antler Orogeny developed along a north-northeast trending swath through northwest Elko County, Nevada, and on into southwestern Idaho. The Cedar Mountain GRA lies west of the axis of the Antler orogenic belt. As a direct result of the Antler orogenic uplift, a Pennsylvanian clastic wedge developed along the margins of the uplift. Some of these exogeosynclinal sediments may exist at depth within the Cedar Mountain GRA. The Antler Orogeny culminated in a period of extensive thrust faulting that includes the Roberts' Mountain thrust.

Major Pre-Tertiary structural elements within the Cedar Mountain GRA are concealed beneath the thick volcanic and volcaniclastic cover. A few north-to-east trending faults are mapped in the area. It is not known whether these faults are reactivated Pre-Tertiary structures or are young structural features.

2.2.4 Paleontology

Late Tertiary and Early Quaternary sedimentary rocks within the Cedar Mountain GRA are similar to those rocks elsewhere that contain several varieties of flora and fauna. Sediments containing Late Miocene mammalian vertebrate fauna occur in tuffaceous lacustrine fine-grained sandstone and siltstone facies[7]. Tertiary diatomites may contain occasional fish and leaf fossils common to lacustrine environments. All other volcanogenic lithologies in the Cedar Mountain GRA are expected to be essentially devoid of fossils. Older fossil-bearing Paleozoic and Mesozoic marine and terrigenous units are not exposed in the Cedar Mountain GRA.

2.2.5 Historical Geology

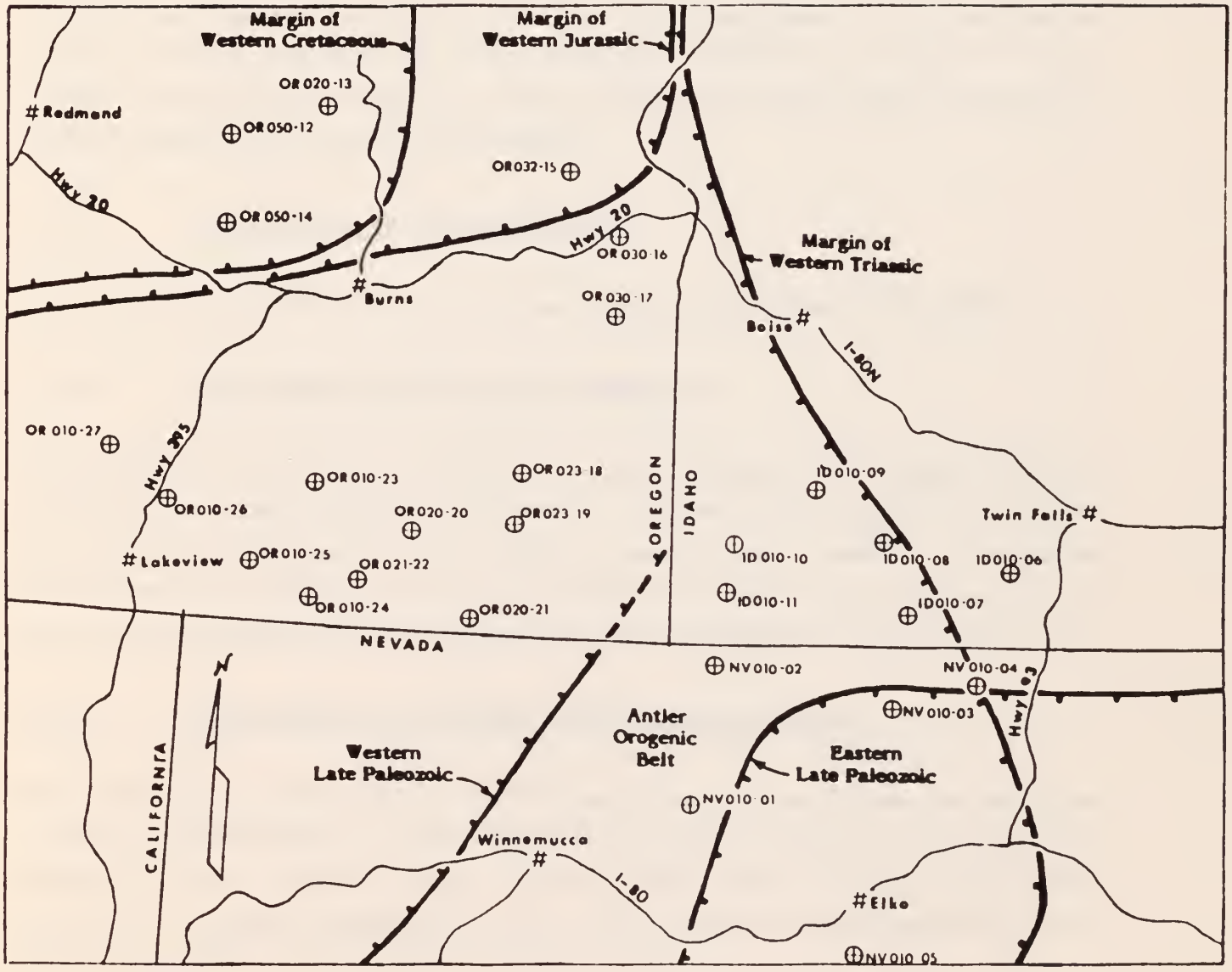
The present geologic character of the tri-state area resulted from the progressive development of the western portion of the North American continent throughout geologic time. Beginning in the Late Precambrian and continuing into the Middle Paleozoic, eastern Nevada, western Utah, southwesternmost Idaho, and eastern Oregon were characterized by a miogeoclinal environment in which shelf margin carbonates, shales, and sandstones were deposited. In contrast, western Nevada and southern Oregon were in a eugeoclinal environment in which dark shales, radiolarian cherts and basaltic materials (Steinman's Trinity) were formed.

The Middle Paleozoic (Late Devonian-Early Mississippian) Antler Orogeny deformed and thrust the eugeoclinal sediments over the shelf-type sediments to the east, resulting in a north-trending highland in Central Nevada (Figure 2-3). A vast amount of fine-grained detritus was shed eastward during the Mississippian, producing thick upper Paleozoic shales in eastern Nevada and western Utah. Coarse sediments were eroded from the Antler Highlands early in the Pennsylvanian. Thousands of feet of sandstone and conglomerate were deposited in northern Nevada aroung the margins of the Antler Highlands. Some of these sediments may exist at depth within the Cedar Mountain GRA. Late Pennsylvanian and Permian shallow-water sediments deposited over the eroded Antler Highlands in the Permian were predominantly of the deep-water variety. The Cedar Mountain GRA is within this depositional basin.

Development of western North America in the Mesozoic was dominated by oceanic plate subduction along the continental margin that resulted in a complex history of concomittant sedimentation, deformation, and igneous acitivty. During this time, the well-defined overthrust belt that extends from Canada to Mexico was formed. This deformation occurred during the Sevier (Late Jurassic to Latest Cretaceous) and Laramide orogenies (Latest Cretaceous to Early Tertiary Eocene).

FIGURE 2-3

Paleogeographic Map[6]
Oregon-Idaho-Nevada
Tri-State Area



2.3 ENVIRONMENTS FAVORABLE FOR GEM RESOURCES

The Cedar Mountain GRA contains a few environments that are variously favorable for the occurrence GEM resources. The area contains environments that are moderately favorable for the occurrence of geothermal, oil and gas, and paleontological resources. Environments also occur in this GRA that have a low favorability for oil shale and tar sands, diatomite, bentonite, and perlite resources. There are no environments that exhibit characteristics favorable for metals, uranium and thorium, coal, limestone, or zeolite resources in the Cedar Mountain GRA.

2.3.1 Environments for Metals Resources

The Cedar Mountain GRA has no environments favorable for deposits of metals[8].

2.3.2 Environments for Oil and Gas Resources

The Cedar Mountain GRA is moderately favorable for potential oil and gas resources. Potentially favorable sub-surface environments include western Triassic and western Late Paleozoic formations, and Miocene Lake Bruneau units[6]. Prospective environments are overlain by Tertiary and Quaternary volcanics and volcaniclastics. The area is partially leased or under lease application for oil and gas, as of 15 August, 1982.

2.3.3 Environments for Oil Shale and Tar Sands Resources

The Cedar Mountain GRA contains the Payette Formation in which there has been noted evidence of oil saturation near Vale, Oregon. Although no occurrences of kerogen-rich shales are known within the Cedar Mountain GRA, it does contain the appropriate lithology. The Cedar Mountain GRA has a low favorability for this occurrence of oil shale resources[9].

2.3.4 Environments for Geothermal Resources

The southern portion of the Cedar Mountain GRA is moderately favorable for geothermal resources. This area contains all of WSA 3-73. Evidence of favorability includes young silicic volcanics, fractured terrain, and the presence of one hot spring[10].

The area along the western margin of Cedar Mountain has a low degree of favorability for geothermal resources. This area is in the western portion of WSA 3-47. Young Quaternary-Tertiary volcanics are found in this area and are the only favorability criteria present. The remainder of the Cedar Mountain GRA is not favorable for geothermal resources.

2.3.5 Environments for Uranium and Thorium Resources

There are no environments favorable for the occurrence of uranium or thorium resources in the Cedar Mountain GRA[11]. Favorable source rocks, potential reductants, and evidence of inferred processes of mineralization are all lacking in this study area.

2.3.6 Environments for Coal Resources

The Cedar Mountain GRA contains low favorability for the occurrence of coal and lignite deposits[12]. The chances for coal or carbonaceous materials to have formed in the study area are remote. The geology of the Cedar Mountain GRA region does not support environments favorable for the formation of coal deposits. The area is underlain or is mantled with accumulations of highly tuffaceous sediments and related volcanic products. There is no evidence to support the inference that a coal-forming environment existed within this GRA.

2.3.7 Environments for Industrial Minerals Resources

The Cedar Mountain GRA contains silicic ash-flow tuffs, and volcanics and lacustrine deposits. These are the lithologies in which deposits of bentonite, perlite, and diatomite could occur. The existence of these lithologies in the Cedar Mountain GRA suggests favorable environments even though no occurrences of these commodities are known in the area[13].

2.3.8 Environments for Paleontological Resources

The Cedar Mountain GRA contains fluvial and lacustrine deposits that are similar to rock units elsewhere that contain a wide variety of flora and fauna. Similar rocks outside the GRA contain fossil vertebrates, both mammalian and reptilian. Although there are no known fossil occurrences in the Cedar Mountain GRA, favorable lithologies are present for this resource[7].

2.3.9 Environments for Geologic Hazards

Potential geologic hazards in the Cedar Mountain GRA consist of mapped and interpreted faults, landslides, and volcanic centers[13]. These features were noted from aerial photographs, geologic maps, and topographic maps. There is no historical record of violent seismic or volcanic activity the area. The potential for mass movement exists along all over-steepened slopes within the GRA.

2.3.10 Educational and Scientific Localities

There are no known ESLs in the Cedar Mountain GRA.

3. ENERGY AND MINERAL RESOURCES IN THE CEDAR MOUNTAIN GRA

The Cedar Mountain GRA is favorable to varying degrees for geothermal, oil and gas, oil shale and tar sands, diatomite, bentonite, perlite, and paleontological resources. The area is not favorable for any other GEM resources.

3.1 KNOWN DEPOSITS

The Cedar Mountain GRA has no known deposits of GEM resources.

3.2 OCCURRENCES

The Cedar Mountain GRA contains one MILS occurrence (hot spring) (Figure 3-1) that is located in the southeastern portion of the GRA. The hot spring in located west of WSA 3-73. There are no CRIB or NURE occurrences or localities within the GRA.

3.3 CLAIMS

The Cedar Mountain GRA contains 28 mining claims (Figure 3-2). They are all located in the eastern portion of the GRA; five claims occur within WSA 3-73. Claims data are current as of 15 August, 1982.

3.4 LEASES

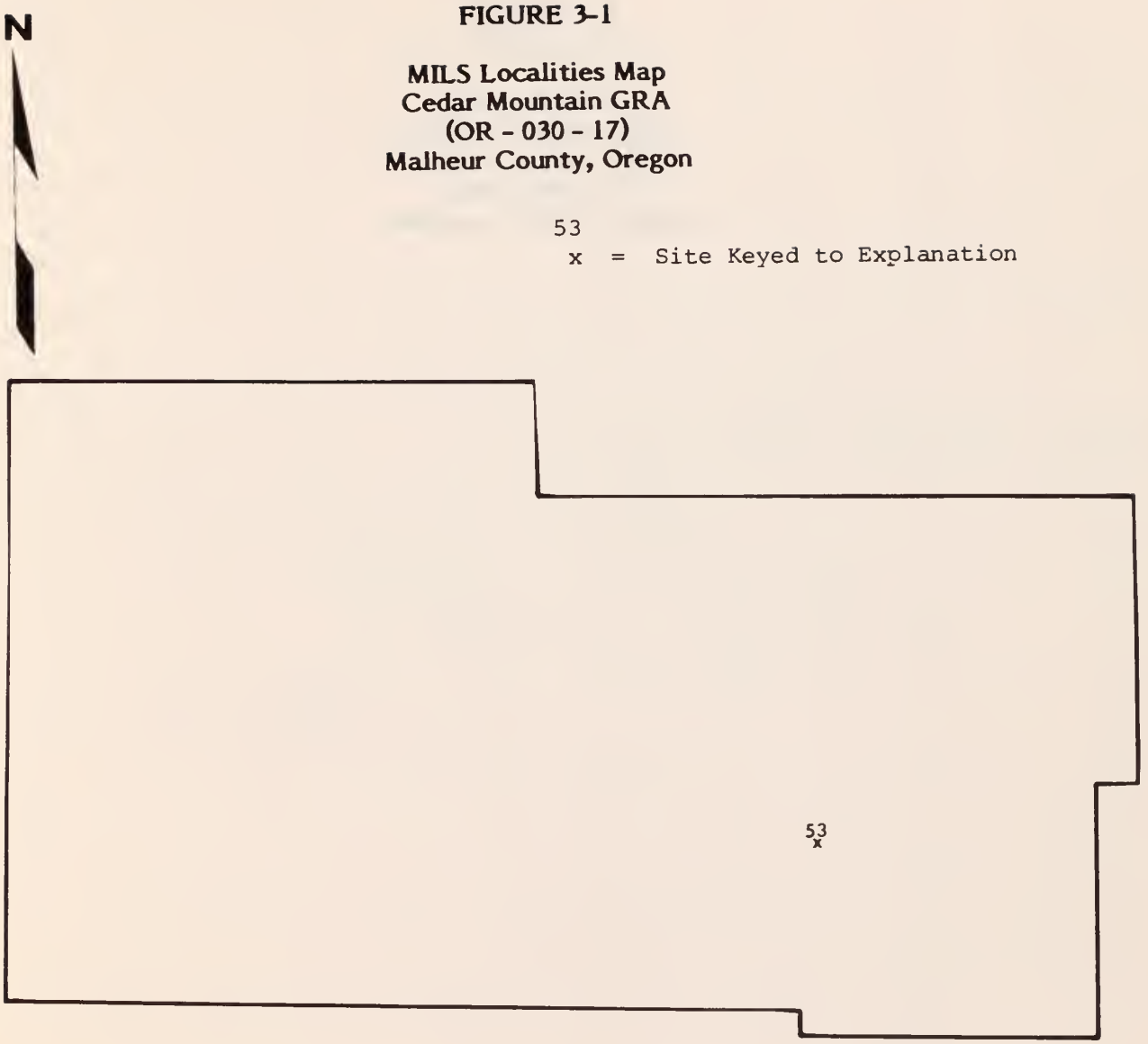
Approximately 50 percent of the Cedar Mountain GRA and only 20 percent of the contained WSAs are currently leased or are under lease application for oil and gas. Lease information is current as of 15 August, 1982.

3.5 DEPOSIT TYPES

There are no known deposits within the Cedar Mountain GRA. Anticipated deposit types, based on the nature of the favorable environments, are low(?)-temperature geothermal, small oil and gas pools, and stratiform deposits of oil shale, diatomite, bentonite and perlite.

FIGURE 3-1

MILS Localities Map
Cedar Mountain GRA
(OR - 030 - 17)
Malheur County, Oregon

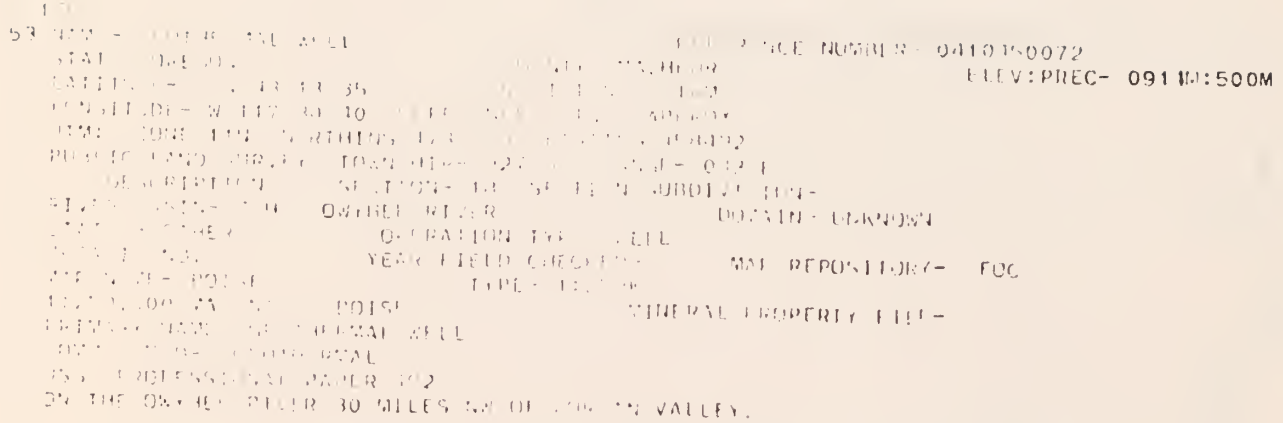


This map is an overlay for Figures 2-1 and 2-2.

Scale 1:250,000
(Boise $1^{o}x2^{o}$ NTMS Quadrangle)

FIGURE 3-1
(Continued)

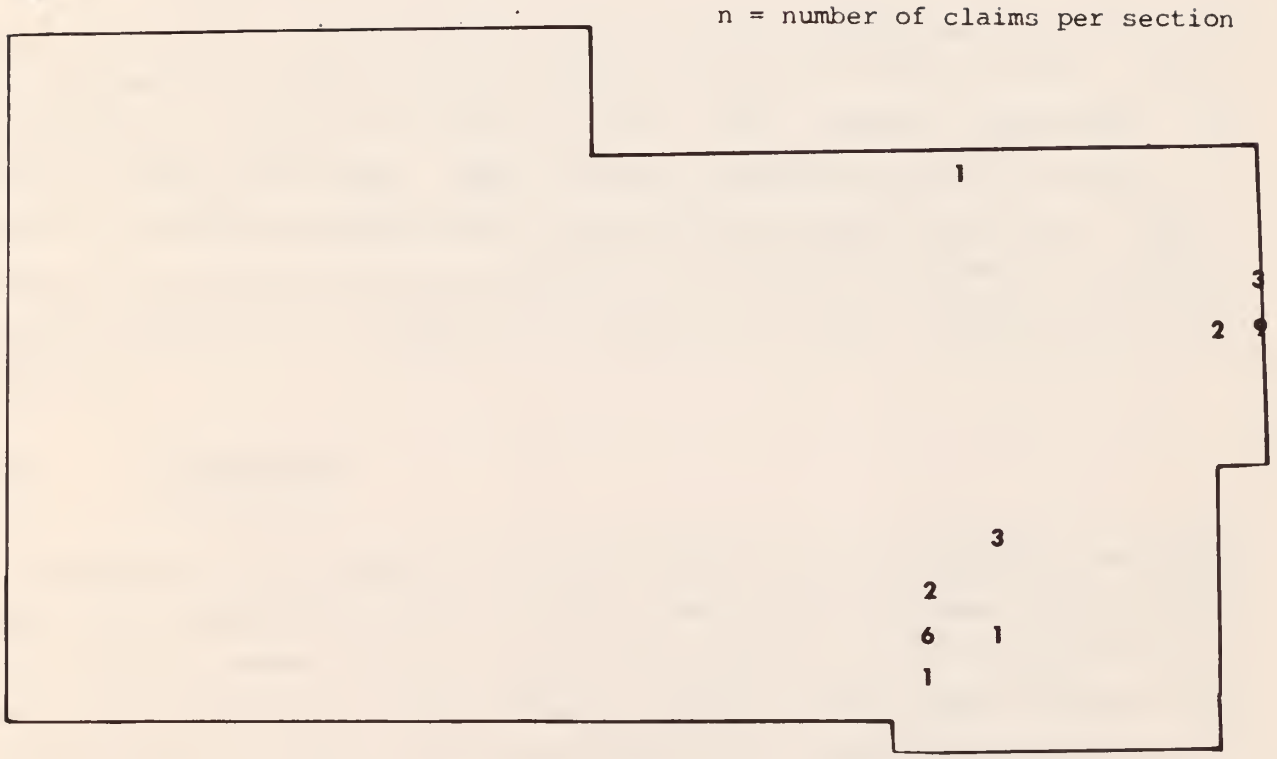
Explanation For
MILS Localities Map
Cedar Mountain GRA
(OR - 030 - 17)
Malheur County, Oregon



N

FIGURE 3-2

Claims Density Map
Cedar Mountain GRA
(OR - 030 - 17)
Malheur County, Oregon



This map is an overlay for Figures 2-1 and 2-2.

Scale 1:250,000
(Boise $1^{o}x2^{o}$ NTMS Quadrangle)

3.6 MINERAL ECONOMICS

Commodities for which the Cedar Mountain GRA is considered moderately favorable are geothermal, oil and gas, and paleontological resources.

3.6.1 Geothermal

Geothermal resources may be classified into two general categories; low-temperature resources (96°F to 196°F), and high-temperature resources (196°F to 302°F). Uses of low-temperature geothermal resources include local industrial, agricultural, and domestic heating applications. High-temperature geothermal resources currently are used only in limited commercial electrical generation and research applications. Supply, demand, and price data are not established for this resource because of the limited amount of production. The importance of geothermal resources is generally of a local nature[10].

3.6.2 Oil and Gas

Oil and gas are vitally important to the industrial growth and development of the United States, and to the overall standard of living. Gross supply and demand trends indicate that during the present decade foreign oil will make up at least 45 percent of our national oil requirements. Present domestic production is 8.6 million barrels per day. The United States currently has a 37 million barrel per day equivalent energy demand. It is predicted that by 1990 the United States will produce 8.8 million barrels of oil per day. The equivalent energy demand will increase to 40 million barrels per day[14]. During this same period, crude oil demand will decrease by nearly 5 percent, from 16 million barrels per day to 14 million barrels per day equivalent. This decrease is thought to be related to an increase in the use and development of other domestic energy sources, consumer conservation practices, and a predicted slight increase in crude oil production by 1990[14]. Because most shallow sources of crude have been or are being depleted, deeper, more difficult targets of oil and gas are being sought. This may result in a rise in the price of crude by 1990 to $61.00 per barrel[14]. This may reverse the trend of surplus supplies that began last year. It also may cause shortages[15].

3.7 STRATEGIC AND CRITICAL MINERALS AND METALS

The Cedar Mountain GRA is not favorable for any strategic or critical metals or minerals as listed in the BLM-supplied compilation given in Table 3-4 of TERRADATA's report entitled "Procedures for the Assessment of Geology, Energy, and Minerals (GEM) Resources."

4. CLASSIFICATION OF LAND FOR GEM RESOURCES POTENTIAL

The precise location of specific favorable environments within a given GRA depends upon three principal factors:

- The precision and specificity of available data;
- The nature (size and spatial distribution) of anticipated deposits as predicted from known models; and
- The geometry of the favorable geologic environments.

Information in the Cedar Mountain GRA is limited and very general. Sub-surface information is virtually non-existent. Therefore, with the exception of geothermal resources, the entire area, rather than specific subareas, has been classified for individual GEM resources (Figure 4-1 and Table 4-1).

The entire Cedar Mountain GRA is moderately favorable for the occurrence of oil and gas. The entire GRA is within the zero edge of the western Late Paleozoic formations, the western Triassic, and the Miocene Lake Bruneau deposits. Insufficient data are available to subdivide the GRA into areas of definitive favorability.

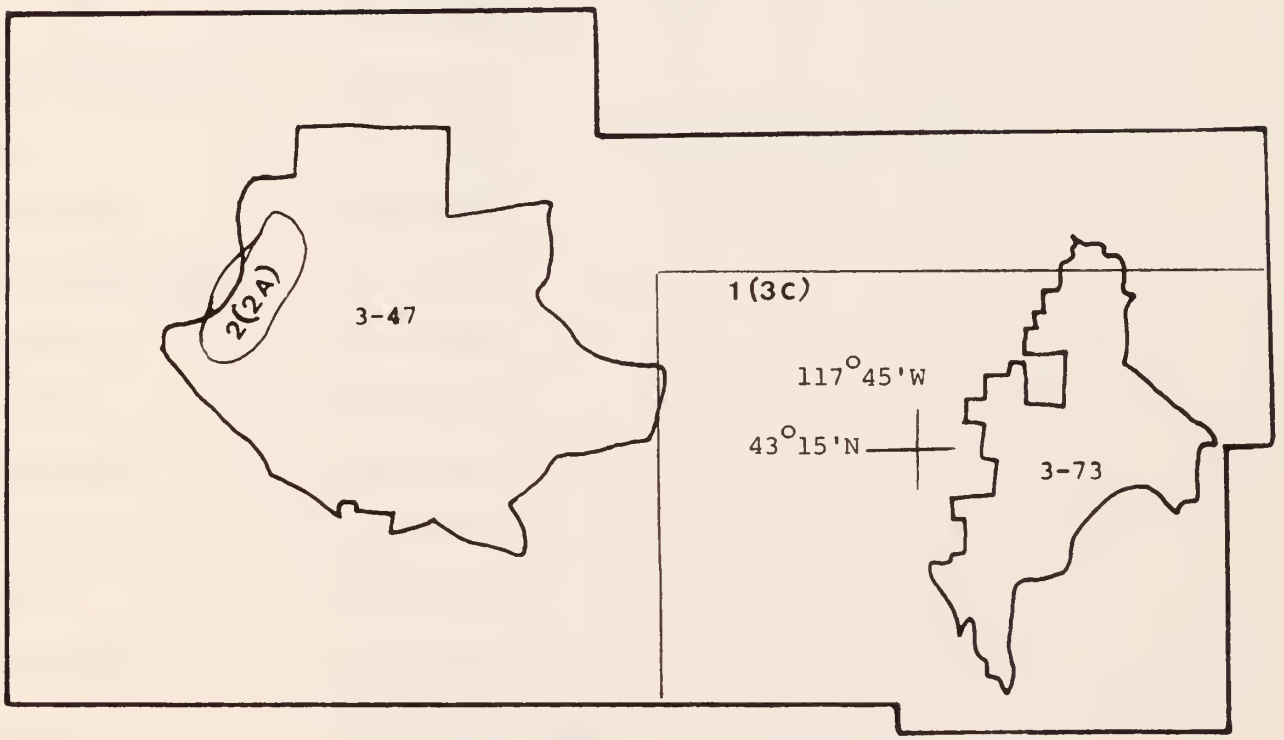
Oil shale, bentonite, diatomite, perlite, and paleontological resources may exist at depth anywhere within the Cedar Mountain GRA. The locations of the environments in which these resources may expected to occur are unpredictable within the volcanic section. Therefore, the entire Cedar Mountain GRA must be considered favorable for these resources.

Geothermal resources have differing degrees of favorability within the Cedar Mountain GRA. The area labeled 1-3C on Figure 4-1 has several prominent recognition criteria, the most important of which is a hot spring (Figure 3-1). Area 2-2A has a low favorability for geothermal resources. The only suggestive criterion in this area is the presence of relatively young volcanics. The remainder of the GRA is not favorable for geothermal resources.

TERRADATA's land classification for geothermal and oil and gas resources is in agreement with the USGS classification of "prospectively valuable" for these resources[17, 18].

FIGURE 4-1

Land Classification Map
Cedar Mountain GRA
(OR-030-17)
Malheur County, Oregon



This map is an overlay for Figures 2-1 and 2-2.

Scale 1:250,000
(Boise 1°x2° NTMS Quadrangle)

TABLE 4-1

Classification Of Lands Within The Cedar Mountain GRA (OR - 030 - 17) Malheur County, Oregon For GEM Resource Potential

COMMODITY	AREA	CLASSIFICATION LEVEL	CONFIDENCE LEVEL	REMARKS
Metals	Entire GRA	1	B	
Geothermal	Area 1-3C	3	C	
	Area 2-2A	2	A	
	Rest of GRA	1	A	
Uranium/Thorium	Entire GRA	1	A	
Coal	Entire GRA	1	B	
Oil and Gas	Entire GRA	3	B	
Tar Sands/Oil Shale	Entire GRA	2	B	
Diatomite	Entire GRA	2	C	
Limestone	Entire GRA	1	C	
Clinoptilolite	Entire GRA	1	A	
Bentonite	Entire GRA	2	A	
Perlite	Entire GRA	2	A	
Paleontology	Entire GRA	3	B	
Hazards	See Hazards Map (GRA File)			
ESLs	None	1	C	

LEGEND:
Class 1 - Least Favorable
Class 2 - Low Favorability
Class 3 - Moderate Favorability
Class 4 - High Favorability

Confidence Level A - Insufficient data or no direct evidence
Confidence Level B - Indirect evidence available
Confidence Level C - Direct evidence but quantitatively minimal
Confidence Level D - Abundant direct and indirect evidence

5. RECOMMENDATIONS FOR FUTURE WORK

Further work in the Cedar Mountain GRA should be designed to increase the confidence levels of the classifications. Detailed surface investigations should be undertaken for recognition criteria for industrial minerals (e.g., weathering phenomena that might produce bentonite, clinoptilolite; ash flow tuffs with possible basal vitrophyres for perlite, etc.); for additional metallic deposits, such as soil chemistry, stream sediment analyses, etc. With the exception of either geophysical investigations or drilling, future work should be confined to detailed mapping, geochemical sampling, and general field exploration.

- APPENDIX A -

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